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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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Forthcoming Events.

Institution of British Foundrymen.

Sheffield Branch.—"Semi-Steel," by J. Cameron, on January 20.

Glasgow Section.—"The Cupola," by D. McQueen, on January 21.

Falkirk Section.—Lecture, with experiments, by A. Campion, on January 21.

East Midland Branch.—"Foundry Facings," by H. Winterton, on January 28, 1922, at Loughborough.

Staffordshire Iron and Steel Institute.

"Electric Welding," by W. H. Walton, on January 21.

West of Scotland Iron and Steel Institute.

"Centrifugal Castings," by J. E. Hurst, on January 20.

British and American High-Speed Steel Practice Compared.

On page 49 of this issue a survey of American high-speed melting practice is given by Mr. A. H. d'Arcambal as a result of a recent tour of inspection. This article reveals that, whilst strongly resembling British practice in many details, American methods differ radically in others. Outstanding amongst these is the higher carbon content usually found in the American material. It runs about 10 points higher, and the use of graphite pots may possibly account for this as far as the crucible variety is concerned. Another outstanding feature is the difference in raw materials. Whilst the British manufacturer has not been able during the war years to use Swedish iron as a base, we feel sure that wherever possible in crucible practice this material would be used. It is to be noted that the pouring of crucible melted material into large ladles is the more popular practice in the States, and yet it is claimed as an advantage of crucible melted steel "that unsurpassed ingots are poured by hand." With this latter statement we are in full agreement, when it is skilfully accomplished, and we would not advise the use of ladles except for ingots larger than the "three-down-twos," where the question of heterogeneity will certainly enter.

It is interesting to learn that in the States it is possible to take four samples during the course of its manufacture by the electric furnace, drill and analyse them. Now high-speed or self-hard steel is not the easiest thing in the world to drill, and this was one of the factors which probably delayed its manufacture in this country by the electric arc process, and even to-day four tests would not be carried through, if results are awaited, much under an hour and a half. The method, which we believe to be the quickest, is to take the red-hot sample into a dark chamber and to quench it in whale oil immediately it becomes invisible. Then in an ordinary gas-fired muffle the oil should be just burnt off. This will allow of its being drilled, but not by any means easily. The estimation of the carbon by combustion takes up more time, and a chemist allowing half an hour between the drawing of the sample and the handing in of the result could not be accused of wasting time.

Another interesting point that is brought out in Mr. d'Arcambal's description is that one American melter thinks that it is poor practice to work under a carbide slag, as the different ingots poured may show a carbon variation of from 0.05 to 0.15 per cent." Obviously, one of the functions of the electric arc furnace is to incorporate reducing conditions in the furnace after slagging in order that the sulphur and gases may be reduced in the metal and that the expensive alloys may give an excellent yield. One of the factors for bringing about these conditions is the powdered carbon (electrodes, retort carbon, anthracite, etc.) additions to a high-lime slag, and if more than is necessary to complete the reactions is added, then the excess on teeming is quite likely to bring about the conditions outlined, but can easily be avoided.

We fail to understand why any firm should use a "packing material such as charcoal and ashes" when annealing high speed, especially the former, as one would expect the bars to be case-hardened. Bituminous coal, placed in the "coffin" or "tube," but out of contact with the bars, is sometimes practised in this country. But this is merely for the purpose of eating up any air, the oxygen of which would scale the surface of the bars.

Briefly, according to this account, we would judge that the British are not being outstripped by the Americans in this particular industry, and the Sheffield trades, backed up by historical associations, skilled workmen, and a hundred laboratories, should hold their own in any market where excellence of material is the sole desideratum.

XUM

Industrial Training for Foundry Workers.*

By Thos. Vickers, C.E., Secretary of the British Cast Iron Research Association.

During the past few years greater attention has been paid to the question of foundry training than in any previous period, and whilst there has been much talk there does not appear to have been much advancement beyond the conditions that existed say 10 or 15 years ago. The subject is, however, of greater importance to-day than it ever was, and affects not only the economic position of the worker but the very existence and character of the industry as a whole.

Industrial training for the worker is no innovation of the 19th or 20th Century. It is but necessary to read the fascinating history of the ancient founders to find how, although their early efforts were crude when compared with their later work, they developed in time a system of art and science all their own, which in conception and execution stands unsurpassed among the creations of any modern nation.

Historical Notes.

The discoveries that have recently been made in Greece convince us that the Egyptians, 6,000 years B.C., had reached a very high degree of mechanical precision, and worked with tools that were marvels of ingenuity and accuracy.

The metal artificers of King Solomon's time must have been possessed of wonderful skill in the casting of metals, judging from the massive bronze castings that were made for the Temple 1005 B.C.

There is no doubt that Tubal Cain was both a brazier and a pattern-maker from the results he obtained. Then, curiously, history from 1000 B.C., so far as the foundry is concerned, is found to be a perfect blank. Something then happened, the promised civilisation lapsed. and there appears a long period, dark and chaotic, until a time is reached when the Greeks started their Guilds of Training, which resulted in a wonderfully rapid advancement in the arts and crafts, especially in the art of bronze founding. Probably the finest example the world possesses in the moulders' art was made at this period, 300 B.C. A piece of work called "The Bronze Horses" are beautiful castings now adorning the front of St. Mark's Cathedral, Venice, as perfect to-day as when made by the moulder 2200 years ago. And so we could go right through this old history of the trade, and see how the early foundations of the training in foundries were laid down—foundations which were made solid and sure for all time, and from which we are, even to-day reaping the benefit. It is then seen how, in the merging of the stone age into that of iron and of bronze, when primitive man began to develop higher grades of implements for warfare and agriculture, the art of the foundry came into existence. For centuries, limited to the casting of bronze weapons and domestic utensils by pouring the precious and dearly won copper alloys into baked clay and permanent stone moulds (for permanent moulds are no 20th century discoverey) cast-iron was but an accident, incidental to the imperfect smelting of iron ores, and was considered highly undesirable.

Whilst, therefore, the art of moulding in its crudest form was known in these early days, the real dawn of the foundry, as an industry useful to the world's development, dates only from the middle of the 15th century. By dint of very great and patient work, and the training of the rough workmen by the founder himself, it was then found that the much despised molten product from the furnaces and forges yielding iron could be cast into moulds of clay and sand to make cannon balls and the like.

Even though the art was closely and jealously guarded the training of apprentices was taken up by the powerful trade guilds of those days, and soon spread knowledge of the art of casting iron far and wide in the then-civilised world.

Coming to a period in the middle of the 16th century, guild classes of foundry apprentices were then found being held during the winter evenings in the County of Sussex. These were probably the first foundry classes in this country. The foundries were situated in isolated places, and the guild classes were held in buildings whose construction allowed the unobstructed entry of the bitter east winds to sweep right through them. But the foundry worker of this period was determined to learn, he was a man held in very high esteem, he was proud of his work, and he worked hard to progress. There is no doubt that this pride of his craft was the first step to the originating of craft guilds, and from these, without doubt, the later trade unions sprung. The training of these old guild classes was not simply a training for a trade, but training also of character and intelligence to make the boy to become an efficient craftsman. What an object lesson it is for the present time!

Worshipful Company of Founders.

In 1590 the ironfounding industry was so powerful and held such a premier position amongst other industries that the Worshipful Company of Founders was formed, and received a coat of arms from the King. The Company's Charter stated that they had to supervise "the manufacture of candlesticks, household utensils, ewers and spurs, *and the training of apprentices.*" An old record of the work of the Company states that it did much good in keeping the craftsmen of that day up to the mark, it maintained the purity of the metals used, and fostered the desire among the workmen to attain the highest possible skill in artistic workmanship. Considerable time could be spent with this fascinating period of old foundry history from 1550, when the first book on iron published in this country was written by Agricola, and the great struggles of these early founders down to 1800 could be usefully studied, when it would be seen how their primitive knowledge and science triumphed over all their difficulties, and it will be found that the incentive in those days was the continual anxiety of the young guild apprentice to learn his trade.

Is the craftsman of to-day as proud of his trade or occupation as the old artificers? If one could say "yes" to this question, there would not be quite the necessity to discuss so much the subject of industrial training, neither would there be the scarcity of good moulders in the foundries that we find to-day. Is it not worth while to alter such a condition? Engineering mechanics who assist in building a great bridge are proud to discuss such an occupation, although they are but following out the principles and design laid down by the chief engineer and designer, and errors and failures do not affect them. A moulder, however, has to bring to bear the personal human-element and skill, and his work stands out prominently as his own personal achievement, and these achievements are often such that no skilled engineering mechanic could carry out. The most perfect casting in the world is one that it is said a great engineer prophesied could not possibly be carried out, namely, the great bell at Moscow, 19 ft. high and 19 ft. dia., weighing 200 tons, which was cast in 1733, this bell being the work and contrivance of an old working moulder. This fine example of the moulder's art does not stand alone in the proud achievements carried out. Therefore, the first stage in attempting industrial foundry training should be to get the workers to regard their trade as a craft and have pride in belonging to it.

The industry has made many strides since the first moulding machine was patented in 1869, followed by the first jolt machine in 1878, especially in organisation and quantity production, and while many of the foundry operations of to-day are similar to those carried out in the 17th century it has to be admitted that it would tax our present skill and resources to duplicate some of the productions of the ancient foundry. For the moulders then reached a very high state of excellence, in fact it can safely be said that the work produced between the years 1510 and 1670 has never since been surpassed or even equalled by the present-day moulder. An examination of the beautiful cast-iron monumental slabs scattered about the

* A Paper read before the Coventry and London Branches of the Institution of British Foundrymen on January 11 and 12 respectively.

churches in Sussex, and the cast-iron grate backs with their wonderful ornamental work are all worthy of examination by would-be moulders.

The present-day moulder should always bear in mind that he and his trade are the direct descendants, from a craft point of view, of those great moulders who produced the wonderful and beautiful bronze sculpture and works of art before cast-iron was ever heard of, and whose skill was the wonder of the then civilised world. He should remember that his work requires great technical skill if he wants to be a good moulder, and if he realises this and lives up to it his trade will command greater respect.

Whilst the achievements of those early days—considering there was a total absence of any scientific knowledge—in the reproduction of artistic masterpieces, and the prototypes of our modern ordnance, cannot but fill us with great admiration for the display of skill in artisanship, patience in development of their work, and hardship endured in their training, yet it must be remembered that after all it was a rule of thumb procedure, and very little progress was made in the industry as an industry. The countless failures experienced by these crudely trained men were, of course, hidden (as probably they are to-day) by remelting the scrap produced, and for every apprentice who became a successful foundryman it was recorded that scores of others remained content to be labourers.

Still, it must be noted that despite all our modern technical instruction and so-called training, so far as moulding is concerned, modern development has added very little to the art as known in the 17th and 18th centuries. In fact one could almost say that it has declined with the introduction of labour-saving machinery.

What can be learnt, therefore, from the work and example of those old founders?

Modern Requirements.

The rule of thumb methods, the secret and mysterious processes, so jealously guarded by our industry, are gradually disappearing. Through the efforts of the Institution of British Foundrymen and technical literature, the results attained by progressive foundrymen are now placed at the disposal of all who wish to avail themselves of the knowledge. In the foundry business, as in any other, there is no royal road to success, and while the young man may be willing to work and study he is at present handicapped by a naturally limited viewpoint. The men in charge of foundries, with their wider experience, should consider it as much their duty to encourage mental development of the younger men in their charge as it is to develop their own skill. Industrial training does not only apply to the foundry apprentice, but it is very necessary for all grades of the organisation, which really means the improvement of the human element in our foundries. There is, without doubt, a definite need for better educated men on the productive side of our foundries; this is being keenly appreciated in America. The term "educated" does not imply a higher-grade or grammar-school man, but *that* education which gives a breadth of view and which develops an appreciation of the human aspect no less acute than that relating to the inanimate features of the foundry. The greatest asset of such a man is the capacity to impart knowledge and method as to why and wherefore things are done to those around or under him. But this teaching is a thing which one rarely finds in any works. It is the improvement of the human element that will have to be brought about in the foundry industry, for it is possible that it has not been given its true value when measured by the cost of the finished casting. This is especially liable to be the case in ironfoundry work where the operations are so varied that it might have been considered that the ordinary foundry worker could not possibly feel interested in the processes involved, viewed as a whole. It is, however certain that men cannot intelligently avoid making poor product if they do not know what constitutes poor product, which condition exists in our foundries more than is generally supposed.

Importance of Human Element.

The foundry industry can be considered in its broad outlines to consist of three elements—recorded knowledge of the foundry art; the human organisation by which this knowledge is translated into useful work, and the mechanical facilities of production. All these three are of fundamental importance, but the second—the human organisation—outranks the other two in vital character.

Suppose it were possible to eliminate at one sweep all the recorded experience of a foundry, the metally-recorded experiences of the trained skilled men would, after a pause for readjustment, enable production to go on just as before. It can be readily seen that out of the wreck the fundamentals would emerge intact, because they had become an integral part of thought and habit through the training of the foundry hands.

And also if the mechanical tools of production were suddenly wiped out of existence, men immediately would begin the construction of other facilities possibly better than before.

Again reverting to a similar procedure with regard to labour itself. The opportunities for rapid reconstruction would not exist were it necessary to replace completely the entire foundry labour organisation. Its physical form, of course, could be duplicated without any difficulty, but instead of a temporary pause for reconstruction there would be a long period of inactivity until the new and untrained staff were able to take up the task of production in the place of the old trained staff. We therefore clearly see that the human element is the pivot upon which success of the foundry entirely depends, and any failure to improve or train this element in any of its integral parts is bound to endanger the future of the industry.

From a psychological standpoint the following would appear worthy of consideration when discussing what is good for the industry.

The moulders' trade, it is admitted, is a very hard one. The physical work involved is severe—so much so that one seldom sees old men in the foundry; the average age of a moulder in this country is about 40. The class of men hitherto attracted have been men of strength rather than of high mental development. Fortunately, through various causes—one no doubt being the educational work of the Institution—there is a distinct change in recent years in the class of moulder working in many foundries, men of broader views and attainments being employed.

Nevertheless, even the uneducated moulders of quite recent times were highly skilled artisans and knew their trade. This, however, cannot always be said of the moulders of to-day, and in many foundries it has become a problem to keep up the supply of first-class moulders, and not let the industry descend to a level where all operatives are human machines capable of making but one thing well and failing at all others. This problem is far more serious than is realised by the foundry worker himself. The development of dry sand methods of production is crowding out the loam mould with its demands upon knowledge of moulding. Foundries to-day are gradually beginning to specialise more or less, and in doing so are putting in modern mechanical equipment. Instead, therefore, of putting on the skilled moulder we shall find that the foundry proprietor will go into the street and pick up the best available unskilled labourer. What will this mean? No industry can live if this becomes the general rule, for unless enough boys are trained from the ground up in every branch of the foundry, progress will automatically be cut off when the older generation of trained men finally cease working. This is a very serious matter, and not merely a statement of platitudes.

Conditions in Foundries.

There is no doubt very great room for improvement in the condition of some of our foundries, yet if compared with the conditions that existed 20 or 30 years ago wonderful progress has been made, and many foundries to-day are really fit to house human being during working hours. Foundry work itself has made rapid strides in improvement. Transportation of material, the melting processes, the handling of the cast product, all have improved, and much of the hard labour of the moulder has been shouldered by the moulding machine. But in spite of all this it has to be admitted that in the actual distribution among the workmen of the fundamental knowledge of the founder's art and in the training of the foundry youth no advance has been made.

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The work of helping the foundry workman to enable him to give greater returns of good castings, not by mere physical effort but by the application of a better trained intelligence, cannot be started too early. Youths must be attracted to the foundry, so that the supply of skilled moulders may be kept and increased.

The moulders of the past, with all their limitations and handicaps, were true artists in their way; as individuals they turned out no doubt many a clever captain of industry, but collectively they have enabled the making of lines of work only possible with serviceable castings, which have been fundamental in the progress of the world. Unless their knowledge is transmitted to the future generation, and backed by thorough training, the art of making castings is bound to go backward.

The author was recently asked by an employer if he really thought there was any benefit in endeavouring to educate the employé. Undoubtedly, the education of the employés is one of the most powerful single influences which can be brought to bear in the greater development of the industry. Everybody should realise that a man must *know*, in order to *do*. The workman must have knowledge of his work in order to give the best service. Many large works in this country, and more especially in America and Germany, realise this by the introduction of works classes and works schools. These introductions are productive and wise, especially where it is found that an important part of the educational programme is the study of the fundamentals of the industry itself.

The Effort of the B.C.I.R.A.

The British Cast Iron Research Association is now at work in an attempt to improve and modernise the methods of foundry production, and the results of the operations of the Association have already made important changes in the ironfounding industry, and the changes will grow more and more as the work proceeds. What does this convey? Is it possible to obtain the best practical results from that Association's work unless the foundry employé is able to carry out such improvements? As the methods of production alter or are improved, it will become more necessary for foundries to employ trained and better skilled men than they are employing at present. Is such a course economically sound? One has but to look at the enormous strides made during the past ten years in the American foundries in her industrial training system.

Germany entered the contest for industrial wealth late in the day and with many disadvantages, but she has made the most skilful and vigorous use of the complete realisation of the fact that "knowledge is power." The industrial progress of Germany between 1870 and 1914 is amazing to anyone who does not realise the potency of industrial training of the worker which she used to secure her position. Germany has for the last 20 years paid particular attention to the training of her apprentices.

The Dearth of Foundry Classes.

The B.C.I.R.A. has fully realised the necessity of practical training for the foundry employé. It has formed an influential Educational Committee, which has approached the whole of the Technical Institutions in Great Britain with a view to obtaining their co-operation. It has been found that in the whole of the country there are only 21 technical school classes for foundry employés—a most astonishing position. The Association is preparing a suggested syllabus of practical foundry instruction, and will obtain the support of all the various technical schools for its adoption. The Association has obtained powers to offer bursaries and scholarships to foundry apprentices, and these in time will be put into force. As far as the Association can assist, everything will be done to further the training of the apprentice moulder, because upon him will depend the carrying out the future practical work of the Association.

Some Views of Outside Authorities.

The replies received from some of the principals of the technical schools show a deplorable apathy, not only on the part of the foundry proprietor, but on the part of the employé.

A Principal of a large Northern Institute wrote:—

"If employers would exercise the same care in selecting foundry apprentices as they take in selecting apprentices for other trades there would be no difficulty in arranging classes, but for students, whose education and mental outlook are so restricted, even the ordinary course becomes costly to carry out."

Another prominent Principal wrote:—

"That the present conditions are such that there are hundreds of untrained foundry boys, merely wasting their time waiting for some other occupation to turn up, shows a very deplorable condition of that industry."

The question of foundry labour is one of recruitment, training and working conditions.

Efforts Needed.

The frequent turnover of labour, besides being inconvenient, is more expensive than is generally realised by foundry proprietors. In the industry, more than that of any other, the juvenile worker needs sympathetic help and guidance. In engineering works, as a rule, there is a waiting list of applicants for apprentices, and it is not beyond the impossible that such a state can be applied to our future foundries. This can only be done by two methods. By a determined effort on the part of the industry to co-operate with the educational authorities with a view to evolving a scheme of practical foundry education, which will ensure a supply of more highly-trained workers than can be obtained with our present methods—and, secondly, by an improvement in the conditions obtaining in the foundry.

As far back as 1906, technical schools were urged to give more attention to foundry subjects. But they appear to have been very sadly lacking in this respect. A great reason for the apparent failure of the technical school to draw in the foundry boy lies at their own door. Looking carefully over the syllabuses of the 21 foundry classes held during this winter, there are only five which a foundryman can call really practical classes.

The syllabuses do not appear to be drawn up with any idea to attract a boy to attend a night school after a hard day's work, and the majority of the classes are taught by persons who have had very little, if any, practical foundry experience.

The Initiation of the Apprentice.

Obviously, the class of boy employed in the foundry will not attend classes explaining "strains, stresses and physical qualities of materials," to the exclusion of foundry practical work. He is a boy who goes straight from school to take up any job that comes his way. Any job is glorious freedom for him and an opportunity to earn a little for himself. He does not object to core-making or odd work with a moulder in a foundry. For a week or two he finds the experience most interesting, and he does not mind it for six or eight weeks; but gradually he gets disgusted with his own appearance, and if the foundry is in connection with an engineering shop he inevitably gets "marked down" by apprentices and boys in other parts of the works. It is inconsistent, also, with his growing sense of pride to expect him to walk home looking like a street urchin. Moreover, parents get sick of the effort not only to keep him and his clothes clean, but to nullify their effect on the home conditions. A boy will be attracted if he knows the class was being conducted in his own foundry language. It is a condition in America, France and Belgium that every foundry-class instructor shall be a foundry expert. There appears to be among nearly all technical school classes a general system adopted by imparting knowledge on the intensive principle, without developing the student's capacity to apply it to the problem of earning his living.

(To be continued.)

THE IRON AND STEEL INSTITUTE.—The annual meeting of the Institute will take place on Thursday and Friday, May 4 and 5, at the House of the Institution of Civil Engineers, Great George Street, London, S.W.1. The annual dinner will be held on the evening of Thursday, May 4, at the Connaught Rooms, Great Queen Street, London, W.C

Foundry Organisation for Costs and Records.

By P. C. Critchlow.

There are two main essentials in any manufacturing proposition, viz.: Production and cost, and they are inseparable. Some foundries scarcely record their production, and many more fail to record their costs; in fact, it may be said that iron foundries are the last concerns to awaken to the needs and advantages of detailed costs. Yet on account of the keen competition in the business, particularly during a period of industrial depression and bad trade, the foundry is one of the departments of basic production which must cut its costs to the lowest possible figure, and to do this it is necessary to know them. During the coming years profits will not be made, but saved. There are foundries who tell only by the value of their aggregate output over a period whether or not their income exceeds expenditure, while other fairly modern foundries find only what has been spent in bulk on a given contract. Few are in a position to tell the cost of the various castings which are produced, still less to know the items that go to make up the expenditure on these castings *whilst the work is in progress*, and to locate a leakage when and where it occurs.

WORKS ORDER FORM. GENERAL ORDER No.

DETAILS OF ORDER. DATE .....

Delivery Instructions. To .....

Per.....

Remarks:

.....

Works Manager.

FIG. 1.—WORKS ORDER FORM.

Sectionising the Product.

To assist in obtaining these vital essentials, the procedure outlined in this article was evolved. It is in use at one of the largest and best equipped foundries in the country. The system is worked by one shop clerk with an office in the foundry, and by a small general office staff, who carry out the necessary foundry work in conjunction with the larger clerical duties of the engineering works.

It will be observed that the requirements of the accountancy departments have been considered in combination with the works management, and both view points obtained without the cost and friction of a dual organisation.

An initial consideration of supreme importance is the geography of the plant, and its division as a whole into unit sections which obviously will be governed by local existing conditions. The production departments for ordinary grey-iron castings would possibly include sections for (*a*) small castings weighing a few pounds, (*b*) intermediate castings, and (*c*) large castings. In any case there must be a separate pipe department, especially when made in pits, also a cylinder section in addition to the general castings shop where the manufacture includes such types.

INTER DEPARTMENTAL ORDER.

From .....Dept. Time and Material to be charged .....
To .....Dept.

THE FOLLOWING WORK IS REQUIRED:—

Superintendent's Signature .....

Date..... Works Manager's O.K.....

BOOK COPY.

FIG. 2.—THREE COPIES OF THIS FORM ARE MADE ne of which goes to the Department for the execution of the work, one to the Costs Office, and one is a Book Copy.

Bench, floor, and machine moulding must certainly be defined units. Green sand and loam work should be subject to division, and the malleable section must provide separate accounts. Then non-ferrous metals must have a section of their own, and, if possible, each nature of metal in this category should become a specific department.

In a foundry of large dimensions, it would be possible to confine the activities of each of the sections to a separate shop. In other instances certain bays of the building could be allocated to definite types, and if not otherwise possible, an imaginary line may serve to mark off the division between the sections of production. Something of this kind must be decided upon before code numbers can be fixed by the cost accountant.

Form No F 16.

(PIECE) (DAY) WORK INSTRUCTION.

Date.....Time.....Worker's Name and No.....
Make.....to Order No.....

Job No	Hours Worked	Good	Defective	Abeyance	P.W. Price	

Foreman's Signature.....

Fig. 3.—WORK INSTRUCTION FORM.

Where a separate cupola is not practical for a section nor a melting furnace reserved for each of the different non-ferrous metals, the cupola charge sheet will supply the necessary information for the quantity and quality of the metal to be debited to the different departments. The need of this will be readily apparent, as even in grey-iron castings there is such a margin in the value of, say, cylinder iron and that for open-sand plates, and the cost must be borne by that department which uses up the metal.

These matters will be determined mainly by individual conditions and the works management, but the works accountant who can visualise the problem in all its bearings will be in a position to make suggestions which, if they do not conflict with actual productions, tend towards simplicity of procedure and clarity of records, and in consequence of greater assistance to scientific management. Some such division cannot be too strongly recommended. It has time and again been demonstrated, but while the rates for moulding and coremaking have been kept within profitable limits, the blanket spread of on-cost charged alike over all classes of production has led to one type of casting bearing a loss which was made by another. The time may come when the contingencies of the market result in the type of work which does not pay filling the shop. Then the policy of profit on one job covering up losses on another is the ostrich plan of safety.

FOUNDRY.

Clock No. .....

Name .....

Date .....

H.P. 23591.

Job No.	Quan.	Description.

FIG. 3a.—THE REVERSE SIDE OF FORM SHOWN IN FIG. 3.

C

Allocation of Order Numbers.

To illustrate what has already been said in the code of standing order numbers set out later, aluminium and other non-ferrous metals have separate melting charges, controlled by use of initial letters A and N. Other costs on these sections are guarded by the same prefixes given to general order numbers for such metal.

Similarly the sections of grey-iron manufacture include No. 78, General Section, which is the code number for foundry in the combined factory list; F. 9 signifies cylinder section; F. 10 floor moulders; F. 11, machine moulders; F. 12, core-makers. The standing order numbers are kept as simple as possible, so that they can be easily understood and used by the employés.

How Orders are Dealt with.

Orders either from outside customers or any other branch of the same factory should be centralised at an official order office. For every type of casting a separate order is issued bearing a number by which the job is known in the shop. The foundry manager sends a works order to each of the departments concerned with the job. The job is progressed on the back of the order by the shop clerk on the particular copy of the section order in so far as the work done relates to the section, showing numbers of castings made and also the weight.

The order number must be used on all work instruction cards and stores requisitions for all direct wages and for all material which enters into the work. It is an advantage to use a separate series of order numbers for work done for outside customers and internal use. General orders are prefixed by "A" for aluminium and "N.F." for other non-ferrous castings. A copy of the works order as issued from the manager's office is shown in Fig. 1. All orders should, without exception, originate at the official order office.

FORM NO. 4.

SECTION..... WEEK ENDING.....

Clock No.	Part or Job No.	Oper. or Dept. No.	Production Hours.								Production		Time Allowance		Hours Payable.		Operation or Job Wages.			Total Wages		
			Sun.	M.	Tu.	W.	Th.	F.	Sat.	Total.	Good.	Scrap	Piece.	Total.	P.	D.						

FIG. 4.—WAGES ANALYSIS SHEET.

MALES. M

No.....

Week ending .....19.....

Name .....

Only Clock Stampings will be recognised.

DAY		IN	OUT	IN	OUT	Ord. Time	Over-time
W	A.M.						
	P.M.						
Th	A.M.						
	P.M.						
F	A.M.						
	P.M.						
Sa	A.M.						
	P.M.						
Sun	A.M.						
	P.M.						
M	A.M.						
	P.M.						
T	A.M.						
	P.M.						

Total Time.....

Hours.		Rate	£	s.	d.
	Ordinary Time				
	Overtime				
	Extra				
	Total	£			

FIG. 5.—ARRANGEMENT OF TIME RECORDING FORM.

On-Cost Charges.

On-cost charges are covered by standing order numbers similar to the following:—

A.1.—Aluminium melting.
N.F.1.—Other non-ferrous melting.
F.1.—Cupola labour, etc.
F.2.—Sand mixing and grinding.
F.3.—Jobbing cores.
F.4.—General labourers and crane drivers.
F.5.—Works clerical staff (timekeepers, etc.).
F.6.—Supervision.
F.7.—Dressers.
F.8.—Machine shop.
F.9.—Cylinder section.
F.10.—Floor moulders.
F.11.—Machine moulders.
F.12.—Core shop.
F.13.—Box parts, grids, etc.
F.14.—Pattern repairs and fitting.
F.15.—Maintenance of buildings.
F.16.—Maintenance of fixed plant.
F.17.—Maintenance of loose plant.
F.18.—Maintenance of electrical plant.
F.19.—Maintenance of compressor plant.
F.20.—Maintenance of tools.
F.21.—Maintenance of office equipment.
F.22.—Inspection and testing.
F.23.—Despatch and transport.
F.24.—Idle time—(*a*) waiting for iron; (*b*) waiting for job; and (*c*) waiting for crane or machine breakdown.
F.25.—Stores.
F.30 and upwards.—Stock lines, with a separate number for each article of production.

A separate series of numbers for expenditure of a capital nature is used. The numbers are not given here as they can easily be arranged to suit the circumstances of each case.

When a foreman requires work to be done by any other department, application is made through his superintendent, who fills in a requisition or an inter-departmental order form (shown in Fig. 2) and forwards it via the manager. The allocation or code number is inserted by the costs office, and the foreman executing the work must see that time spent and material used on the job are charged correctly to the code number.

In cases where work of a minor nature is required for a job which has previously been sanctioned by the management, a sub-order may be used bearing, of course, the classification appearing on the parent order.

These general instructions though stated briefly are important. They are the basis of the whole procedure and their strict observance is fundamental to its success.

Wages.

Operators engaged on any work should be possessed of a work instruction card, shown in Fig. 3, to be produced at any time when required

by the management. It should bear the correct allocation or order number, against which time and material are to be charged. The card being filled in and signed by the foreman at the commencement of each job or shift. A separate card must be issued for each job or type of casting. The foreman must state on the card, *before* handing it to the operators, whether the job is to be done on daywork or on piecework basis, also he must be certain that the job and order numbers are correctly stated in the space provided. Cards showing day work on production orders for which a piece-rate has been fixed should not be accepted unless they are signed by the rate-fixer while the work is in progress, and a reason is given for the departure from piecework. When the operator receives his work instruction card he hands it to the shop clerk, who immediately stamps the time thereon. When the operator, having finished a job, obtains a new work instruction card, the same procedure is again observed. It follows, therefore, that the difference between the clocked times gives the time chargeable on each particular job. When a casting is ready for removal to the dressing shop a progress man collects it, also the work instruction card from the clerk, and delivers the card and the work to the inspection bench. The work is examined and the results of inspection are entered on the card, which is then taken to the shop clerk at the completion of the job or at the close of the shift. A fresh card must be used by each operator at the commencement of each shift.

All work done, whatever may be the nature, falls into one of two categories, namely, productive and non-productive labour.

Productive workers are the operators who actually make the mould or cores from which the casting is eventually made, whether floor, bench, or machine moulded. Likewise in the machine and fitting shops the operator who shapes or assembles the actual job is classed as a producing unit. In the case of standing orders, productive workers use the space headed "job number" on the card for floor, machine and cylinder moulding, core-making, etc. The term job number in this case may appear to be a misnomer, but the language of the shop has been used so that the operator himself should understand.

Non-productive workers fill in the same space with the standing order denoting the nature of the work upon which they are engaged.

If a worker is transferred from one class of labour to another, that is to say from productive to non-productive or vice versa, or from one non-productive job to another non-productive job, a fresh card must be obtained.

This means that foremen never give verbal orders unless confirmed by instruction cards, and the clock stampings on the cards ensure correct time charges of labour expense against all services.

After dressing the number of castings, and the finished weights are inserted on the work instruction card by the progress man or inspector. This applies to all castings whether saleable, defective, or tackle.

When an operator books on to idle time, the shop clerk must immediately send a rush order on the form shown on Fig. 2 to the department concerned with removing the cause of stoppage, *e.g.*, to engineers' department or tool room in the case of machine breakdown or tool requirements. The time is clock stamped on each order. When the repair or otherwise is completed, the repair man is booked off the job, and the machine number or other information is quoted on his time slip. The idle time of each operator and the reason for it can then be checked against the orders showing times of breakdown and repairs effected.

The particulars as shown on work instruction cards should be immediately entered up in time book, shown in Fig. 4. This record is completed daily by the shop clerk, and represents a complete analysis of each workman's time for the week. As each work instruction card is completed, the details as to job number, department or order chargeable, number of hours actually worked, production, scrap in number and weight, and piecework time allowance are entered up in the time sheets, and at the end of the week extended to show hours payable against each order or job. This is arrived at in case of piecework by multiplying the production, *i.e.*, castings accepted by the inspection department, by the piecework time-allowance or rate per cwt. on the job. The total of actual hours worked on all jobs is compared

M

No.

NAME.....

THIS SIDE OUT.

Gross Wages			
Good Timekeeping Bonus			
Special War Bonus			
Output Bonus			
DEDUCTIONS			
Welfare			
State Insurance, Health ..			
„ „ Unemployment			
TOTAL WAGES DUE	£		

Extended by	Checked by

FIG. 5A.—THE REVERSE SIDE OF FIG. 5.

DEPT. TURN

FOREMAN'S DAILY PRODUCTION REPORT

DATE SECTION

Names of Operators.	Job Number.	Order Number.	Piece Work Time.	Hours Worked	Actual Production.	Planned Production.	% of Efficiency	Clock No.	Remarks.

Foreman's Signature.....

FIG. 6.—FOREMAN'S DAILY PRODUCTION REPORT.

with the factory clocking-on card, any discrepancies being cleared up immediately.

At the end of the week the clock cards (Fig. 5) are totalled up by the time office and delivered without any delay to the shop clerk, who enters the hours or weight payable as to piecework or daywork—this information being ascertained from the time sheets—and then forwards the completed clock cards to the office for the making up of wages. By this system the shop clerk at the end of the week has only the job worked on last to enter on the time sheet. Immediately this is done, the extension of hours, etc., payable is commenced, and the result is transferred from time sheets to clock cards, a good supply of which will thus be available for the wages clerks within a few hours after the close of the final shift of the week.

The work instruction card is a vital document and provides the particulars for further records. Care must be taken in copying the data from this card, and any apparent error must be rectified.

The completed time sheets are forwarded to the costs office for abstract and analysis immediately they are available.

All time sheets must be completed with the details of production per man so that a man-efficiency report for the previous day may be prepared and handed to the manager not later than 10 o'clock each morning. This is prepared in accordance with form as shown on Fig. 6. The previous day's record is entered for every producing and piecework operator, and one sheet for each section is used.

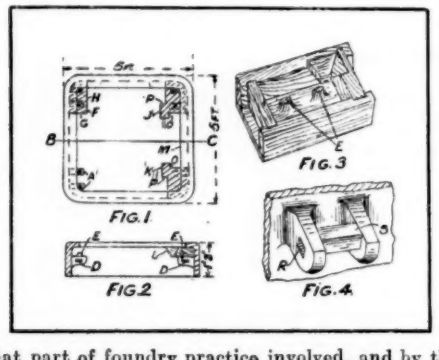
The aggregate man-efficiency reveals departmental efficiency. By turning up the time sheets any moulder's record in production and efficiency can be proved over any period. Thus the manager has in his own office and at his finger-ends the essential data for individual praise or censure.

(To be continued.)

The Accurate Locating of Cores.

By F. C. Edwards.

The positioning of dry-sand cores is generally effected by allowing a core-print to project from the face of the pattern either in the bottom, top, or side, whichever is most suitable. This projection usually represents a continuation of the core itself, and the degree of accuracy obtainable depends upon the position of the print and the correspondence of print to core. There are cases, however, where, for various reasons, it is impracticable to carry a print of the same shape as the core required beyond the face of the pattern. Such problems can only be effectually solved by a complete grasp, on the part of the patternmaker of



that part of foundry practice involved, and by the exercise of a certain amount of ingenuity in devising means to meet the actual conditions of the particular job in question.

A typical example, comprising features common to many classes of work, is given in Fig. 1, which is the plan of a frame casting. A pair of bearing brackets are cast in each of the four corners, as at A. These brackets are situated about midway in the depth of the frame, as shown in Fig. 2, which is a section along B, C, Fig. 1. They carry slot bearings D, and bosses E. These slots and bosses are required to be very accurately cast with regard to position and their relation to each other.

As in most problems affecting the foundry, there are several "permissible" methods of coring these brackets, but only one "best" way. One method is shown at F, Fig. 1, where the sectioned part represents the core-print. This would be quite satisfactory in most cases. It is, however, unsuitable for the job under consideration, for, unless the cores are held firmly against faces G and H, the bosses E, which are formed on the underside of the cores, as shown in the core-box, Fig. 3, would be found out of position when the casting was made. This liability to displacement of the cores, therefore, negatives the method where strict accuracy is required. Prints on the bottom side of the cores must also be ruled out in this case, for the brackets are in the way, and, since the moulder cannot see underneath the core when he is lowering it into the mould, a special print would not help matters; the print impression would be subject to injury, and thus rendered useless as a reliable guide.

The method of printing as at J and K, Fig. 1, is, perhaps, the best combination of simplicity and accuracy. The print is also shown at L, Fig. 2. It will be observed that this print does not extend to the top of the frame. The reason for this apparent lapse in best practice is, that there is a continuous internal lip, M, Fig. 1, round the frame, which would probably suffer in appearance, where the corner dry-sand cores joined up with the green sand. The steps, O, P, furnish the required complementary guides to the faces G, H, of print F, definitely fixing the position of the cores. To facilitate easy withdrawal, and thus minimise mould disturbance, a large amount of taper is given to these prints. Incidentally, this taper is given to the core-box, from which the cores are made, and ensures a perfect core. Two core-boxes, right and left hand, are required, one of which is shown in Fig. 3.

The slot bearings, D, Fig. 2, are formed by means of a single core extending through both brackets, as at R, Fig. 4, in which the top print is removed. A reliable guide is provided by the connecting print S, which ensures perfect alignment of the slots.

In moulding, the slot core (which is made to stop up completely the print S) is placed in the print and covered by the top core, which holds it securely in position.

Finally, oil cores are used, giving clean, sharp corners, and the castings produced seldom vary as much as 1-16th in.

Publications Received.

J. Stone & Company, Limited, Deptford, London, S.E.14. A vest-pocket diary.

"The Swedish Year Book, 1922." Price 7s. 6d. net. London: Messrs. Williams & Norgate, 14, Henrietta Street, Covent Garden, W.C.

Messrs. John Macdonald & Sons, Limited, Wall Street, Maryhill, Glasgow. Calendars for the current year, with descriptive particulars of Macdonald cupolas (Taylor's Patent) and sand shakers, electrically-driven; very economical riddles, with circular motion, as by hand.

"Bulletin of the Cleveland Technical Institute," December, 1921. A monthly periodical containing abstracts of the most important scientific articles published during the month. Compiled and edited by the Director and Secretary, Edward L. Johnson, Corporation Road, Middlesbrough.

Messrs. National Engineering Company, of 549, W. Washington Boulevard, Chicago, U.S.A. "The Simpson Foundry Mixer." Describes the firm's latest developments in all types of sand mills. Tests are given, showing that a higher breaking load is obtained from test pieces prepared from the type of mill they market than from hand prepared mixtures.

Under the registered trade mark, "Perfpart," Mr. George Thompson, Clevedon Works, Conybere Street, Birmingham, has introduced to the trade Price's Perfect Partings, for foundry and casting shop, taking the form of a superfine powder which, dusted lightly over patterns (loose or plate), ensures a perfect parting. It gives a good lift every time, and the casting produced is clean and sharp. It is suitable for castings in any metal, from the smallest to the largest size, and for machine-moulding or repetition work is invaluable.

American High-Speed Steel Practice.

By A. H. d'Arcambal (Metallurgist to Pratt and Whitnes Company, Hartford, Conn).

Crucible Practice.

The process as used to-day by most of the large American tool-steel works is as follows:—

The base, usually high-grade muck bar,* is carefully weighed. Most works use about 50 lbs. to the charge (90 or 100 lbs.). Before the war Swedish iron was used to a large extent in this country for the high-speed base, but has recently been difficult to procure. It is the opinion of some American manufacturers, and vigorously disputed by others, that just as good a base is made in the States. One of the mills informed me they were using "Armco" iron for the base, another mill uses another special open-hearth product; but the majority of the plants have found that muck bar, which is almost pure iron, gives the best results.

High-speed scrap is then weighed. This consists of crop ends, bar ends, etc., and usually makes up about 25 per cent. of the charge, or 25 lbs. In the medicine room, so called, the ferro-alloys are very carefully weighed and placed in pails, which also contain ground brick dust for a fluxing agent. These alloys, such as ferro-tungsten, ferro-vanadium, ferro-chromium, ferro-manganese, and ferro-silicon, constitute the remaining 25 per cent. of the charge. The ferro-alloys are refined in the electric furnace, and usually carry the following percentages of the alloying element:—

Ferro-tungsten	75 to 85 per cent. tungsten
Ferro-vanadium	33 to 35 per cent. vanadium
Ferro-chromium	60 to 70 per cent. chromium
Ferro-manganese ...	75 to 80 per cent. manganese
Ferro-silicon	48 to 50 per cent. silicon

The proportion of the various alloys added as well as the amount of base and scrap used depends, of course, on the analysis required. Sometimes it is necessary to add "Armco" washed metal—a white iron containing 3 to 4 per cent. carbon, low in manganese, phosphorus, sulphur, and silicon—to raise the carbon, while some works add a small amount of charcoal. However, carbon is usually controlled by varying the amount of scrap and ferro-chromium.

The material is now ready to be charged into crucibles. Crucibles used in America are made from a half-and-half mixture of flake graphite and clay. To prevent the graphite in the crucibles dissolving in the steel, they are usually lined with pure clay, lasting for four to six heats, the crucibles then being used for carbon tool-steel melting. One works superintendent states that he does not use this clay lining, but melts high-speed steel in crucibles which have been used for three or four melts of carbon tool-steel. He says that steel absorbs only a very little carbon from crucibles which have been used several times.

Ferro-alloys, especially the ferro-tungsten, are added near the centre of the charge, to insure thorough mixing.

In order to maintain a neutral atmosphere, graphite covers are placed on the crucibles, which are then lowered into the furnace, each "hole" usually providing room for six crucibles. The size of the furnace is expressed by the number of crucibles it contains, such as 30, 36 or 42 crucible pot furnaces, and would contain, therefore, five, six or seven "holes." These furnaces are of the regenerative type, usually producer-gas fired, and will melt the heat in 3½ to 4½ hours. After thorough melting, the heat continues for half an hour more to permit gases in the molten steel to escape and to bring the steel to the proper casting temperature. This is known as the "killing" process.

Workmen then pull out these pots with large tongs. As it is necessary for them to straddle the open hole while it is at a temperature of about 1,650 deg. C., they first wrap their legs and body in burlap, put on heavy shoes with wood and iron soles, drench themselves with cold water, and after covering their hands and arms with water-soaked bags are ready for "pulling out." Considering the fact that these crucibles weigh over 100 lbs., the job is not an easy one. Steel in these crucibles is then poured into moulds or into a large preheated ladle and poured from the latter into the moulds. The latter practice is more popular in America and gives a more uniform analysis, ingot to ingot.

* Muck bar is genuine wrought iron. Impurities existing in pig-iron of special grade are oxidised in a puddling furnace, the pasty iron sponge removed from the furnace in a ball or lump, most of the slag squeezed out, and the rough bloom resulting is rolled directly into a flat bar known as muck bar or puddle bar. Short pieces of muck bar are bundled, reheated to welding heat, and rolled one or more times before being marketed in the form of wrought-iron bar or pipe.

Electric Furnace Practice.

Raw materials used in electric furnace melting depend to a large extent on the available scrap supply. A well-known manufacturer of high-speed steel states that limestone should never be used in the electric furnace process, for when it is present the heat melts with an oxidising slag, causing a large loss in alloys. Lime in any form also slows the furnace working, and he states that there is always enough slag left in the furnace to take care of the subsequent heat while melting. He is also of the opinion that it is not necessary to introduce silica into the furnace, and that retort carbon should be used for carburising in place of ground electrodes, because of the greater purity of the former. Such variations of opinion are given merely as a matter of record, without an attempt to appraise them critically.

Raw materials should be carefully analysed, for it must be remembered that it is desirable to use just as pure materials in electric furnace melting as it is necessary to use in the crucible process. Material showing high phosphorus, sulphur, nickel, arsenic, tin, copper, antimony, or bismuth should not be used.

Furnace Operations.

Furnace operations, as usually carried out, are as follows:—Limestone, if used, is first charged on the bottom of the furnace, washed metal next, then muck bar, high-speed scrap, and ferro-tungsten. The amount of high-speed scrap added usually runs from 30 to 40 per cent., one works, however, claiming that 70 per cent. scrap may be used if properly selected. Electrodes are then lowered, current turned on, and the steel melted, usually under neutral conditions. From two to three hours is required to bring the charge to a molten condition, and approximately 600 kw.-hours per ton of steel is consumed. A sample for analysis is usually taken at this point.

Slag is now removed and a new slag made of lime, fluorspar, and ground electrodes, which maintains a strongly reducing atmosphere as well as a basic reaction toward the metal, thus eliminating oxygen and sulphur. A higher temperature is also usually used during this period to produce the desired chemical reactions. As soon as the bath is thoroughly deoxidised, ferro-chromium, ferro-tungsten, and ferro-manganese are added; ferro-vanadium, the last alloy added, is usually introduced about 30 to 45 minutes before tapping; a short time before the heat is tapped ferro-silicon is introduced. Silica in small quantities is occasionally used to thin the slag. One large American works usually makes five analyses during melting, the first being made as soon as the steel is melted, the others taken from time to time after recarburisation, depending largely on the slag conditions. The last test is taken shortly before tapping. Five analyses obtained by this works on one of their heats ran as follows:—

	Test No. 1. Per Cent.	Test No. 2. Per Cent.	Test Nos. 3 and 4. Per Cent.	Test No. 5. Per Cent.
C.	0.43	0.43	0.59	0.69
S.	—	—	—	0.29
Mn.	—	—	—	0.35
S.	—	—	—	Trace
P.	—	—	—	0.019
W.	17.29	—	—	18.48
Cr.	1.90	—	—	4.03
V.	0.26	—	—	0.98

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When the heat is ready to tap, the slag is greyish white, containing carbide, and producing acetylene gas when thrown in water. One melter thinks that it is poor practice to work under a carbide slag, as the different ingots poured may show a carbon variation of from 0.05 to 0.15 per cent., depending on the strength of the slag. Other operators say it would be almost an impossibility to eliminate this carbide slag.

Hot electric metal must be "killed" the same as in the crucible process. Correct pouring temperature as well as the condition of the metal is determined by pouring and examining small test ingots, and when the metal is ready the furnace is tilted and the steel poured into a heated ladle. After the hot steel is permitted to stand in the ladle several minutes to allow the trapped non-metallic particles to rise to the surface, the steel is teemed into moulds.

Works making electric-furnace high-speed steel claim the following advantages for their process over the crucible melted product:—(1) Any desired temperature can be obtained; (2) more accurate chemical control is possible; (3) impurities in original raw materials may be eliminated; (4) better mixing of ingredients is effected.

The advantages of the crucible melted high-speed steel over the electric furnace material are said to be as follows:—(1) A more careful examination of base materials is required; (2) steel is melted in small units; (3) a neutral atmosphere is maintained in the crucible; (4) unsurpassed ingots are poured by hand.

Ingot Practice.

Liquid steel, produced from either of the above processes, is usually cast into split iron-moulds with solid bottoms. These moulds are tapered, and set with the large end up. On top of these moulds rest preheated "dozzles," or fireclay shells, whose outside dimensions are the same as the inside dimensions of the moulds. These hot tops act as reservoirs holding molten steel to feed the shrinkage cavities and eliminate piping to a marked degree. Moulds are smoked so as to eliminate surface defects on the ingot.

When the ingots have cooled sufficiently, they are stripped from the moulds. At this point the practice varies in different works. The majority immediately anneal the ingots after they are stripped so as to remove all casting strains and to refine the grain as much as possible.

The ingots are usually sampled for complete analysis, and whether annealed or unannealed are then carefully examined for surface defects. Imperfections are ground or chipped out. A small corner is also usually broken off and the fracture examined.

Ingots are then charged into large heating furnaces, coal or oil fired, and allowed to remain until they have been thoroughly heated to a temperature of approximately 1,149 deg. C. They are then hammered by large steam hammers and reduced to billets. The piped end is then cropped off, usually amounting to from 10 to 20 per cent. of the weight of the ingot. Billets are again carefully examined for surface defects, usually the entire surface is ground, and a careful examination of a fractured surface is also made. Billets are then charged into reheating furnaces and heated through to the proper temperature for further reduction. In most cases billets are annealed before being reheated. Finishing to size is done either under hammers or in rolls. A short time ago some interesting experiments were conducted by Messrs. Andrew and Green of Messrs. Armstrong, Whitworth & Company, Limited, to ascertain the comparative effect of hammering or rolling on the microstructure of high-speed steel, and no difference was observed, contrary to the widely held opinion that hammering produces a better product than rolling.

Finished bars are usually placed in large tubes, the ends sealed and the tubes then rolled into annealing furnaces, equipped with from four to twelve pyrometers connected to autographic recorders. Furnaces and contents are then brought up to from 816 to 870 deg. C., held there for a considerable length of time, then slowly cooled in the furnace, an operation requiring from 2 to 3 days. It will usually produce a Brinell hardness of from 196 to 235, depending on the size of the material being annealed. A few works use a packing material such as charcoal and ashes in the large tubes, but it is claimed that greater uniformity is obtained without this. A rapid method of annealing high-speed steel is to heat to 899 deg. C., cool slowly to 704 deg. C., and then air-cool. This will give a Brinell hardness of from 228 to 269, but the method is not used much in this country, as the consumers usually require a softer material.

Annealed bars are then carefully examined with a file for surface defects, their size measured, and both ends nicked and broken to examine the fracture for grain and pipe. Material is also tested for Brinell hardness. Most of the works follow their steel through the different operations; it is identified with the proper heat number so as to know the analysis and history of the finished stock.

One impression left on the writer after inspecting the various tool-steel works was the influence of the metallurgical department on the quality of the finished product. An accurate chemical control of the raw materials and the finished product is essential if a good, uniform product is to be manufactured. Metallurgical supervision of the casting, cogging and annealing temperatures insures material properly fabricated. In one of the large works the metallurgical department had full control of all inspection. All of the works visited had adequate chemical laboratories, and in the majority of cases well-equipped physical testing departments and metallographic laboratories. It was quite noticeable that in some the metallurgical equipment was not used nearly as much as in some of the other mills visited, but the latter were the plants whose products are ranked among the best in the country.

One often hears it said, mostly by men connected with the tool-steel industry, that the analysis of high-speed steel is no indication of its cutting qualities. This statement is true, for in more than one instance two different brands of high-speed steel, with approximately the same analysis, have shown altogether different cutting qualities. This does not mean, however, that the analysis specification is not important and should not be enforced. A large number of rejections have been made because of insufficient carbon, tungsten, or vanadium, for such material would surely produce inferior tools. It is, of course, a mistake to purchase high-speed steel under a chemical analysis only, as the microstructure, Brinell hardness and fracture in hardened bar are of such importance that they should be included in the specifications. Yet control of the chemical composition is a step toward uniformity, which is of great importance to any steel product.—"Chemical and Metallurgical Engineering."

The Utrecht Steel Works.—The report of the directors of the Nederlandsche Staal Fabricken (late J. M. de Muinck Keizer), of Utrecht, Holland, for the year 1920-21, states that at the beginning of the financial year it appeared that the results of working would not fall behind those in the preceding twelve months. But the sudden decline in the activity of the Dutch metal industry at the opening of 1921, coinciding with an accentuation of foreign competition, had an adverse influence on the results, so that the profits realised for the whole year were only moderate. The same factors were also responsible for the new open-hearth furnace and the rolling mill not having yet been set in operation, seeing that the working of them would not have proved remunerative. The new electric furnace, however, was started last May in lieu of the Bessemer plant, and the results obtained with the manufacture of electric steel were very favourable. The new financial year down to November has not produced any favourable financial results. The few orders obtained for the steel foundry had to be accepted at low prices under the pressure of foreign competition. In the hope of seeing prices for rolled steel rise, the directors had intended to start a part of the rolling mill at the beginning of November, but this was frustrated by the strike in the metal industry, due to a reduction in wages, which was unavoidable under existing circumstances if works are to be kept in operation to some extent. The accounts show gross profits of 249,910 florins (say £20,820 at par) for 1920-21, as compared with 742,556 florins (say under £62,000) in 1919-20. After allowing for general expenses, interest, doubtful debts, etc., and writing off 72,807 florins for depreciation (60,785 florins in 1919-20), there remains a balance of 152,847 florins, which has been carried forward. This compares with a dividend at the rate of 10 per cent. for 1919-20.

XUM

Institution of British Foundrymen.

BIRMINGHAM BRANCH.

At a meeting of the Birmingham Branch on December 10, held at the Birmingham Municipal Technical School, Mr. J. Shaw read his well-known Paper on "Some Perplexing Foundry Problems."

SOME PERPLEXING FOUNDRY PROBLEMS.

THE CHAIRMAN (Mr. W. J. Flavell) reminded the members of the interest taken in the Branch by Mr. Shaw when he was a member. Since then Mr. Shaw had been connected with one of the Government Departments, and was now at Sheffield with Messrs. The Brightside Foundry Company. When the conference was held at Blackpool Mr. Shaw gave this Paper, and it was followed by a most interesting discussion. The Council of the Birmingham Branch thought it would be very useful and interesting to the Birmingham Branch if they could get it repeated so that they could have a further discussion on it.

Co-operation with the B.E.S.A. Essential.

MR. H. L. REASON, in proposing a vote of thanks to Mr. Shaw for his Paper, said a very great honour was conferred upon Mr. Shaw during the war when he was taken on as an expert on cast iron at the Ministry. Mr. Shaw came in close contact with the troubles in the various foundries that were called upon to meet very high tests required in connection with munitions, and this, coupled with his previous experience in connection with test bars and the study he had given the question since the war, had led him to induce the Institution to give the question serious consideration. He agreed with Mr. Shaw that the Institution should advise authorities empowered to lay down specifications for cast-iron test-bars. He (the speaker) had had quite ten years' experience with the British Engineering Standards Association, and his experience of them and their management was that they never put a specification into force until they had consulted both the manufacturers and users. It was their duty as an Institution to pursue this question and to ascertain where they could assist the B.E.S.A. to prepare specifications which could be worked in such a manner that they were not at the mercy of the whims of an Inspector, and so that they could produce their test-bars with a regularity that was not going to bring forth trouble. The Institution could pursue their work up to a certain point, but when they wanted research which was going to cost much money they had to stop. They were now in the very happy position of having the B.C.I.R.A. constituted for this purpose.

Square and Round Test-bars.

MR. FRANK HOLBERRY, in seconding the motion, said, with regard to test-bars, he agreed with Mr. Shaw that there ought to be standardised test-bars if they were to obtain correct readings or any satisfactory results. He would like to ask what Mr. Shaw thought would be the difference in a tensile-bar cast square and turned round and a bar which was cast round.

The vote of thanks was heartily accorded to Mr. Shaw.

Difficulty of Producing Pig-Irons to Analysis.

MR. J. E. FLETCHER, Director of Research, B.C.I.R.A., said Mr. Shaw had practically introduced two definite topics. The first was a very tempting one, and one of vital importance. There was some reason why two irons of similar chemical composition should give physically different results, and Mr. Shaw had hinted at one thing that might possibly account for it. Those who had had any experience with blast-furnace work, with hot- and cold-blast irons, knew that there was a difference between two such irons although they might be made practically from the same materials. The difference in the temperature of the working in the furnace was, at any rate to his mind, the chief reason for the difference. There were several things that seemed to fix the physical conditions of cast iron, and the first in importance, as in the case of steel, was carbon. Whether carbon was relatively high or relatively low had a great deal to do with the physical condition of the material. If it was high it would, if cast hot and chilled rapidly, give a certain result. If it was high in carbon, cast hot and cooled very slowly, it would give another result, and the result Mr. Shaw mentioned as a kind of freak was not altogether a freak. He had seen it many times, and it was due largely to certain furnace operations that had caused the iron in the well of the furnace to become desiliconised. Especially in the older type of slow-running furnaces this sort of iron was not at all unusual. He had seen it sometimes when a furnace had had a "hard tap," and instead of being tapped at the usual, say, 12 o'clock, it was tapped at 6 o'clock next morning. He thought as foundrymen they ought to recognise the great difficulties of the blast-furnacemen. Too much was said, as if the blast-furnaceman, with his unwieldy, gigantic furnace, could operate it as though he were operating a Siemens-Martin furnace. It was impossible to do anything of the kind. He was hampered to-day, and he would apparently be increasingly hampered in future with ores that were physically finer, more siliceous and more difficult to deal with, and he also had his fuel problem. It was certainly getting a little better now, but when the chemist tried to take out of the coke what some considered was the best part of it and gave the remaining coke to the blast-furnaceman to do what he could with it there was something resulting from that difficulty which perplexed the foundryman from day to day. During the war they had coke, occasionally, which contained 10 to 15 per cent. of moisture and which contained over 15 per cent. of ash. That was the sort of coke with which foundry metal had to be made during the war to give some of the results that engineers expected. There was no wondering at the variable results that had been obtained. The blast furnacemen went to his pyrometer and expected to find his 1,100 or 1,200 deg. and found instead 750, and he had burdened his furnace for a certain expected stove-temperature. He had burdened it with his limestone, and it took a temperature of 1,000 deg. before it melted the slag, probably, and under these conditions the blast-furnaceman had to work. It was a most difficult problem. He saw practically from day to day the difficulties that blast-furnacemen had, and though they were grappling with them as well as they possibly could, the product varied. When they went to the modern blast-furnace, with its big hearth and high rate of driving, and took analyses at various parts of the bed and found considerable variations, then what was the blast-furnaceman to do? How could he deal with it? The result was that the iron had to be graded according largely to fracture. Theoretically, it should be graded largely according to analysis, but when they had a dozen different varieties of iron in the one bed how could it be graded by analysis? Of course, it was largely a carbon question, but there was also the variation in manganese and silicon. The differences were largely due to temperature control in the blast-furnace. So far as irons were concerned having the same analysis and giving different physical results, a great deal depended there, of course, upon the rate at which the pig-iron had been cooled and the later cupola metal. He had records year by year of irons made in the same furnaces in the winter and in the summer with the same burdens. During the winter time the iron was of a different nature from that in the summer, and these were very difficult matters for the foundryman to understand when he got pigs that analysed the same or very nearly the same. There was a very serious and important ratio between the combined carbon and the graphitic carbon in iron. That ratio had to do really with the rate of iron cooling. If they took the iron and quenched it right out in iced brine they would get from the same iron nothing but practically combined carbon and little or no graphite at all. The question of cooling had a very great deal to do with the difficulties that Mr. Shaw had mentioned.

Test-bars.

With respect to the test, he entirely agreed with Mr. Shaw that if any sort of representative test was to be made, a tensile or a transverse test, it should have some relation to the rate of cooling and some ratio to the thickness of the casting that

the bar was to represent, and it would be a matter of experiment and judgment along those lines. They were suffering from having tests prepared for them, made to fit almost every condition without considering that one casting cooled quickly and another slowly. He thought the tensile test-bar should be made from a round bar, cast dry-sand, and cast carefully as the Americans had suggested. The question had not been tackled as it ought to have been in this country, and it was a matter for the I.B.F., in conjunction with the B.C.I.R.A., as well as for those who made the material. They did stand for a committee or a council of advice and arbitration when it came to really seriously considering what should be the British standard test-bar for cast iron. He thought, too, that the transverse test ought to be on the same lines as the tensile test, if it could be. An 18-in. transverse test would be very much better than a 12-in., and if a round test machined flat on two sides could be made for that purpose it would be very much better.

Mercury in Pig-iron.

MR. R. BUCHANAN thought it was probably right to say that oxides had a marked influence on molten grey iron. Pig-iron was such a complex body that they knew very little about it, and he mentioned that somewhere in the Technical School was a bottle containing liquid mercury which he obtained from solid pigs. He agreed that pigs did differ, although the analyses were similar. He was quite in accord with what Mr. Shaw had said as regarded the difficulty of getting a test-bar which would indicate the strength of the casting which it was supposed to represent. He recalled that he wrote a Paper fourteen or sixteen years ago which he called "The False Witness of the Test-Bar," the idea of which was to show that although test-bars were honestly made and cast from the same metal as what was going into the casting, they did not represent the casting as regarded the strength which the casting would be. He suggested that where it was possible that the casting should be tested to destruction. He agreed that it was desirable test-bars should be more related to the thickness of the casting which they represented. As regarded a circular test-bar being better than a 36 in. × 2 in. × 1 in., he confessed that he never met difficulties with the latter bar. In his opinion, the deflection of a transverse test-bar was more instructive than the breaking stress of a tensile-bar.

Test-bars should represent the Metal.

MR. D. WILKINSON said that after a long experience in test-bars of steel, cast iron and non-ferrous metals he had come to the conclusion that the test-bar should not represent the casting, but only the metal put into that casting. It had seemed to him for some time that as regarded cast iron the whole question wanted handling carefully and revising. It was comparatively well known now what quality of iron was required to make a heavy, a medium and a light casting. What was to prevent careful research being carried out for a period by various manufacturers who were making satisfactory castings of various descriptions on one standard test-bar made in a certain definite manner and tabulating all the results they obtained? Then, after a lengthy period, if all these various results were compared, they ought then to obtain a definite standard of strength, both tensile and transverse, which would give fairly accurately the character of the metal required for various castings. As regarded the shape of the test-bars, that was a very wide question. A circular test-bar in steel cast vertically was useless. It was all a question of crystallisation. The centre of a round steel test-bar was always open and weak. Similar conditions occurred with brass. Concerning the variation in analyses and properties, he said they had all known for a long time that analyses, no matter how carefully carried out, were not the last word. It must be some property of the metal itself.

MR. A. PARSONS inquired whether the metallurgist and chemist were justified in taking it for granted that the pure metallic content for cast iron was constant. With regard to test-bars, from the experience he had had of the chemical compositions of iron, there certainly seemed to be a wide range of chill for identical compositions. He was not going to lay all the blame on the composition, because they were up against the human element.

The Lecturer's Reply.

MR. SHAW, replying upon the discussion, stated that he was pleased the various speakers were in agreement that the Institution should put forward some definite proposals for specifications and tests for cast iron. Their position on this matter would then be quite clear. Mr. Fletcher and others had endorsed his (the speaker's) view, that the size of the test-bar should bear some relation to the thickness of the casting it represented. To have three sizes of bar might be cumbersome, but this was infinitely superior to the American specification with varying test results on the same size bar. It was often stated that the test-bar result was no criterion that the casting would give the same result, due to difference in the rate of cooling, etc. Whilst this was true, the bar at least gave the customer some idea of the quality of the metal used, and he could make comparative figures. If it be taken for granted that the test-bar does not necessarily represent the strength of the casting, there can be no objection to having a round test-bar, cast vertically in dry sand. This would eliminate a number of variables, such as chilled corners, wet sand, etc. In shost, conditions would be more stable and results more comparable. Whilst agreeing with all Mr. Fletcher had said as to the effects of quicker or slower cooling of metal on the physical test results, he knew he also agreed that these results are also altered by time and temperature effects in the furnace itself, even when showing the same ultimate analysis. He also endorsed all he said with regard to the difficulties of the blast-furnace manager. His quarrel with the latter was that they should put "off" iron through the furnace again, or warn his customer, for it is often sent out to find its level and cause trouble. After thanking Mr. Wilkinson for the list of irons that bore out his contention, he referred to oxides, and said no definite conclusion could be drawn until some fairly accurate method of their determination had been found. This is a function of the B.C.I.R.A., who will no doubt, if it is at all possible, some day clear up this matter. With regard to Mr. Parsons' question, it must be taken for granted that pure iron is always the same, and that it is the effects of the other elements that gives the variation in strengths and other properties.

Pig-iron and Steel Output in December.

According to the National Federation of Iron and Steel Manufacturers, the production of pig-iron in December amounted to 275,000 tons, a figure slightly in excess of the production in November, when it was 271,800 tons. The furnaces in blast at the end of December numbered 77, compared with 85 at the end of November, 15 furnaces having gone out of blast during the month and 7 re-lit. The production of pig-iron for the year amounted to 2,611,400 tons, compared with 8,007,900 tons in 1920. This figure is lower than in any year since 1850, when the production of pig-iron amounted to 2,249,000 tons. Of the production of pig-iron in December, 92,400 tons were hematite, 81,500 tons were basic, 13,800 tons were forge, and 78,600 tons were foundry.

The production of steel ingots and castings in December amounted to 381,000 tons, or 62,000 less than November. The total production of steel for the year amounted to 3,624,800 tons, compared with 9,056,800 in 1920.

THE GREAT value of co-ordination between the costs departments and the production departments of large works was demonstrated in a paper read on December 30, at the Institution of Production Engineers, in London, by Mr. H. G. Hales, the works manager of Drummond Bros., Limited, of Guildford. Mr. Hales emphasised the importance of making use of the production man's intimate knowledge of works conditions when drafting forms relating to the cost of manufacturing operations, as well as the necessity for more assistance from the cost department, in the supply of figures of cost to the works executive as a constant guide in effecting economy in production, and also for discovering abnormal expenditure on any given part or operation.

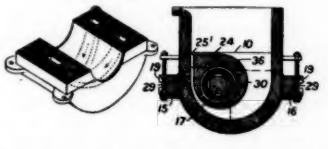
Patent Specification Abridgements.

Particulars of Patent Specification Abridgements, furnished by Mr. Eric Potter, Patent Agent, of 27, Chancery Lane, W.C.2, and Commerce Chambers, Parliament Street, Nottingham.

Printed copies of the Specifications of the following are now on sale.

170,046. WYATT, J. R., 1257, Empire Avenue, Camden, New Jersey, U.S.A. Electric furnaces. June 9, 1920. No. 15614.

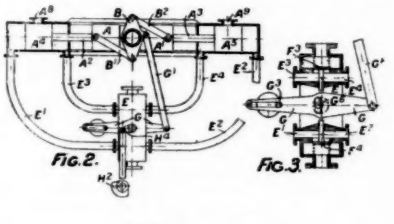
Induction Furnaces.—In a furnace having a narrow channel which opens at its ends into a pool of molten metal and surrounds one limb of an iron core, one end of the channel is arranged to produce electro-dynamic flow of the molten metal. Fig. 1 shows a channel narrow at one end 25^1 and widening towards the other end. The core may be displaced from the centre of the intermediate refractory mass 36 towards the narrow part of the channel and optionally downwards. Unidirectional circulation is produced in consequence of the sharp angle at one end, the obtuse angle at the other end, and the tapering form of the channel. A groove 24 in the bottom of the main chamber connects the ends of the channel. In another form

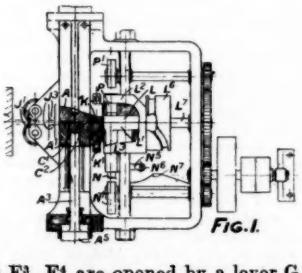


the channel is branched so that electro-dynamic action at the dividing angle produces circulation, which is increased by forming a sharp angle at one end and an obtuse angle at the other end of the channel. The core may be eccentric and circulation may also be increased or diminished by tapering the channel. In making either of the above forms of furnace, asbestos paste may be rammed around a destructible core, having the shape of the channel, and between an outer insulating-band 29, Fig. 1, and inner band 30 around the primary winding. The iron core 15, 16 is held by angle-irons 19. Parts of the casing are held together by bolts and brackets.

170,194. LATTA, J., and LATTA, J. D., of Scottish Stamping & Engineering Company, Limited, Neptune Works, Ayr. Forging metals. October 2, 1920, No. 27967.

Comprises a direct-fluid-actuated double-drive machine for producing forgings from a bar, etc. The horizontally moving die-heads A, A^1 are secured to piston-rods A^2, A^3, respectively. The pistons A^4, A^5 move in double-acting cylinders having central exhaust ports A^8, A^9. Steam is supplied through pipes E^1 . . . E^4 from a distributing-valve E, Figs. 2 and 3. The spring-

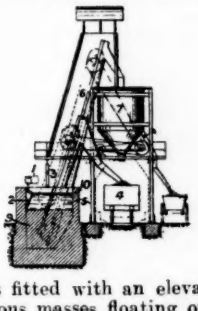




closed valves F^3, F^4 are opened by a lever G which is rocked by a continuously-rotating crank-pin G^3 working in a slot. The other end of the lever is pivoted to a link G^1, pivoted to a second lever B coupled to the die-heads by links B^1, B^2. When the required number of blows has been given to the stock, a cam H^2 rocks a lever H^4 which, by means of a crank-pin G^6 working in a slot in the lever G, moves the lever laterally so that the valves are not opened and the die-heads come to rest to allow the stock to be fed. The stock is fed from a furnace J by sectional rollers J^1 and passes through a guide J^3 to the die-heads, which may have two or more dies C^1, C^2 to effect the forging in stages. From the die-heads the work passes to supporting holders K, K^1, which are separated at the required intervals by a cam on the shaft L^7. From these holders the work passes to slides L, L^1, which have recesses to suit the forgings and are reciprocated, to feed the work, in blocks L^2, L^3 by a cam L^6. The blocks L^2, L^3 and slides are separated at intervals to admit a forging, by a cam on the shaft L^7. The slide L^1 carries a punch N, which is moved in one direction by a cam N^1 to press the forging into a die P and separate it from the connecting-pin. The die P is supported by a rotating cam P^1 and delivers the forging into a receptacle. The punch N is withdrawn by a lever N^5, which is rocked by its roller N^6, bearing on a cam N^7 on the machine framing when the slide L^1 is withdrawn and the blocks separated.

170,287. SCHOL, C. H., Allendorf, Dillkreis, Germany. Porous slag, etc. June 14, 1920, No. 26908. *Convention date, March 7, 1918. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act.*

Apparatus for producing porous masses from slag and similar materials, in which the molten slag falls on to a horizontal or inclined plane 2, from which it flows on to the surface of water



in a vessel 5, is fitted with an elevator 3, which removes the porous masses floating on the surface of the water and a second elevator 6 to remove to a silo 7 the heavy granular portions which sink to the bottom of the depression 9. The shoot 1 may be provided with an alternative outlet from which the slag flows straight into the water to yield the granular product only.

170,100. DIEHL, L. H., 141, Heinrichstrasse, Darmstadt, Germany. Iron manufacture; zinc compounds. July 12, 1920, No. 20885.

Iron ores, roaster-residues, slags, etc., free from sulphur and containing iron and zinc are smelted in a blast furnace with a suitable chloride such as the chloride of an alkali, alkaline earth, or zinc, and the usual ingredients of a blast-furnace charge, the zinc being volatilised in the form of chloride or oxychloride and carried out of the furnace along with the gases which pass into the gas-washing plant, the zinc being absorbed in the alkaline wash-water. The crude precipitate in the form of carbonate is separated, washed and calcined. The iron is tapped off from the furnace and cast into pig-iron, etc. The chloride used in the furnace contains preferably two parts of combined chlorine to one part of zinc in the ore, etc. The solutions from the gas-washing plants may be evaporated and the product used as a chloride in the furnace. When the roaster residues, etc., contain sulphur, they are subjected to a preliminary treatment to remove the sulphur. The residues, etc., are crushed and roasted in rotary kilns with fuel and a limited supply of air, so that a portion of the ferric oxide present is reduced to ferrous oxide, the product being sintered during the roasting. The desulphurised and sintered product is then treated as before in the blast furnace. The gases from this operation may be used in the manufacture of sulphuric acid. If the ores, etc., used are too fine, they are first agglomerated or briquetted in any suitable manner and any deficiency in iron is rectified by the addition of iron ore or scrap iron.

XUM

Trade Talk.

THE BARROW HEMATITE STEEL COMPANY, LIMITED, have put two furnaces into blast.

THE GOLDENDALE IRON COMPANY, LIMITED, put one furnace into blast on Thursday, January 5.

THE HEAD office of Messrs. Morris & Company, copper smelters, etc., has been removed to West Stockwith, Doncaster.

T. MITCHISON, LIMITED, engineers and ship repairers, have opened an office at Mansion House Chambers, Close, Newcastle.

VICKERS, LIMITED, are in receipt of an Admiralty order to construct Diesel engines for a mine-layer, to be built in a Government dockyard.

UNDER THE HEADING "Iron, Brass, etc.," 397 companies, with a capital of £5,927,422, have been registered at Somerset House during 1921.

THE COMBUSTION ENGINEERING COMPANY, of Coventry House, South Place, E.C.2, propose establishing a large foundry in the Derby district.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have gained first place in the list of British shipbuilders for merchant tonnage launched during 1921.

THE CARGO FLEET IRON COMPANY'S iron-ore mine at Twywell, Northamptonshire, was re-opened on Monday last, after being closed for the past eleven months.

NEW wagon works are being erected by the North-Eastern Railway Company at Darlington, together with 200 houses for the accommodation of the workmen.

MESSRS. WM. JACKS & COMPANY, 5, East India Avenue, E.C.3, intimate that on the 28th inst. they are removing to Winchester House, Old Broad Street, London, E.C.2.

UNDER THE EXPORT CREDITS SCHEME, additional credit to the amount of £2,421,000 was sanctioned by the Government between the end of October and the end of the year.

AT a meeting of the North-East Coast Institution of Engineers and Shipbuilders, at Newcastle, recently, Mr. W. S. Burn dealt with the subject of "Diesel-Engine Flexibility."

Two of the orders for new ships given by Sir Walter Runciman have gone to the Northumberland Shipbuilding Company, Limited, and another two have been given to Wm. Doxford & Sons, Limited. Each roughly is of 10,000 tons deadweight

THE CUTLERY TRADES' TECHNICAL SOCIETY has arranged for a series of lectures on the effects of heat treatment on steel, by Dr. Desch, Dr. Longmuir, and Mr. Brearley, for the benefit of cutlery operatives. Mr. Brearley will deal particularly with the subject of the heat treatment of stainless steel. The series begins next month.

SAM MASON, LIMITED, brass founders and engineers, of the Standard and Abbey Works, Alcester, entertained their employés to dinner recently. At the same time, Mr. Sam Mason (chairman of the directors) was the recipient of a presentation as a slight token of the esteem and regard in which he is held by the workpeople and officials.

W. AND S. POLLOCK & COMPANY, of Glasgow, have purchased Wellshot Brewery, Cambuslang, and are reconstructing the whole place for the purposes of an engineering works. A new foundry is being added and plans are being prepared for an extension of the existing buildings. It is the intention of the firm to make their Clyde marine motors at Cambuslang.

MESSRS. ISLES, LIMITED, crane makers, Stanningley, Leeds, have recently appointed Mr. J. G. Clark, 12, Oxford Street, Manchester, their Lancashire representative; also as their London, South of England and South Wales representatives, Messrs. Sir J. F. Payne Gallwey, Brown & Company, Limited, 58, Victoria Street, London, S.W.1, 71, High Street, Southampton, and 50, Charles Street, Cardiff.

THE first general meeting of the West Yorkshire Metallurgical Society will be held at the Y.M.C.A., Huddersfield, on Saturday, January 28, at 6.30 p.m. The President, Mr. T. E. Hull, will deliver the opening address. A debate will take place on the motion: "That physical testing is the duty of the metallurgist rather than the engineer." Proposed by Mr. J. R. Handforth, M.Sc. Opposed by Mr. F. Rowlinson.

THE ANNUAL MEETING of the Sheffield Association of Metallurgists and Metallurgical Chemists was held on Tuesday, Mr. P. B. Henshaw, the retiring president, in the chair. The following officers were elected for the ensuing year:—President, Dr. T. Baker; vice-president, Mr. C. T. Nesbitt; hon. treasurer, Mr. L. Dufty; hon. librarian, Mr. G. B. Willey; hon. secretary, Mr. J. Evans; council, Messrs. G. R. Bolsover, T. P. Colclough, J. H. S. Dickinson, J. H. G. Monypenny (members), Captain H. B. Moorshead, R.N., and H. Rollin (associates). It was decided that the annual subscription shall be 1½ guineas. Dr. T. Baker, the new president, in his address, dealt with the subject of the open-hearth furnace.

AN application has been made by the shipbuilding employers for a joint conference in mid-January, at Carlisle, in order to discuss the question of withdrawing the bonuses granted to employés periodically during the war by the Industrial Court. These bonuses, which amount in all to 26s. 6d. a week, were made on a flat rate basis, and applied to time and piece-rate workers throughout the industry.

MR. C. T. CRAMP, industrial secretary of the National Union of Railwaymen, has circularised branches notifying them that the majority of the railway companies are now prepared to go to arbitration with the N.U.R. and the Federation of Engineering and Shipbuilding Unions, on the question of a national settlement of the wages and conditions of railway shopmen. A meeting will be held shortly to agree on the terms of reference.

TWENTY-THREE LARGE BELLS, of the aggregate weight of 17½ tons, were heard in public for the first time on January 12, when Princess Beatrice and the Duchess of Albany visited the bell foundry of Messrs. Gillett & Johnston, at Croydon. These bells are to be sent shortly to the Metropolitan Church at Toronto. This is the first carillon of bells which has ever been sent to Canada. The bells are a gift from Mr. Chester D. Massey, a citizen of Toronto.

A SOUTH WALES BRANCH of the Institution of Mechanical Engineers has lately been formed in Swansea, with Sir John Roper Wright, Bart., chairman, and Mr. Dd. E. Roberts as vice-chairman. On January 10 the first ordinary general meeting was held at Swansea, Mr. Roberts being in the chair, when Major James Caldwell, M.Inst.C.E., M.I.E.E., read a paper on "Electric Arc Welding in Steel Production."

IN connection with the large order just placed with Braithwaite & Company, Engineers, Limited, of West Bromwich and Newport, Mon., for a steel pipe 114 miles long, 6 ft. diameter, for supplying water to the City of Bombay, India, Royce, Limited, of Manchester, have received an order for the full equipment of electrical overhead travelling cranes, eleven in number, for workshops, which Messrs. Braithwaite are erecting to carry out the work.

THE FURNESS SHIPBUILDING COMPANY, of Haverton Hill-on-Tees, have received the contract for the whole of the constructional steelwork in connection with the order secured by Spencer & Company, Limited, engineers, Melksham, and Henry Simon, Limited, Manchester, for the plant and machinery for grain elevators for the South African Government at Cape Town and Durban. Messrs. Furness have also booked an order for six large oil storage tanks for the Scottish Oils, Limited.

MR. C. R. B. ATKINSON, M.B.E., H.M. Commercial Secretary for Morocco, who will shortly proceed to his post, is at present at the Department of Overseas Trade, and will be pleased to make appointments until January 25 with firms desirous of obtaining information as to the possibilities of extending their trade with Morocco. Firms who wish to take the opportunity of consulting Mr. Atkinson should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting the reference 3617.T.G.

THE DEPARTMENT OF OVERSEAS TRADE is informed by the Legation in London that tenders are invited by the Bulgarian Direction of Posts, Telegraphs and Telephones for the supply of the following material:—Bronze in plates and bars, iron and steel plates and bars, and insulating materials. Tenders will be opened at Sofia, District Department of Finance, at 4 p.m., on February 14. Particulars on application at the Department of Overseas Trade (Room 84), 35, Old Queen Street, Westminster, S.W.1.

AT a meeting of the iron, steel, tinplate and metal merchants' section of the London Chamber of Commerce, which was held on Monday last, the following matters were dealt with:—Correspondence: Franklin Saunders & Company, Limited, *re* notice issued by the Swansea Trust repudiating liability on tinplates entrusted to their care; Standardisation as affecting Iron, Engineering and Building Trades; Iron and Steel Specifications as Understood in Great Britain, the Continent and N. America; Bills of Lading—"Received for Shipment" clause; Export Credits—Extended facilities; railway matters; and the Cancellation of Contracts by Portuguese Traders.

FOLLOWING on their request that the railway managers should receive a deputation on the subject of a general reduction in rates and charges, the Federation of British Industries have sent out a questionnaire to their members. This asks for information on the following points:—To what extent have you diverted traffic from railway to road or water transport? What amount of such traffic would you hand back to railways if rates were reduced to, say, 75 per cent. above 1913 rates? Can you give any idea of what increased tonnage would result from such a reduction in railway rates? Would you increase revenue to railways by sending further distances if rates were only 75 per cent. above 1913 rates? Questions are also asked as to the effect of railway rates on business generally.

IRON AND STEEL MARKETS.

Pig-iron.

Although it is as yet too early to estimate the full effect of the recent substantial reductions in pig-iron prices, not be it observed altogether confined to the cuts in Cleveland makes, it is satisfactory to record that the movements in question have stimulated trade to a certain extent, with the result that more blast furnaces are resuming operations in various districts. In this connection, however, it is disappointing to note that South Staffordshire smelters have not as yet seen their way to following the lead of Midland and Northern ironmasters, on the ground that the inquiries do not indicate a sufficiency of demand to absorb furnace outputs, and that pig manufacturing at present cannot be carried out on a profitable basis. For the time being the majority of the foundries are working short time, or altogether idle, and as this industry constitutes an important factor in consumption of crude iron, a revival of demand can hardly be expected until some recovery is effected in general trade. On Tees-side markets are at last showing signs of improvement, and a limited expansion of business is reported, both on home and overseas account, the fact that foreign competition in pig-iron has been successfully met having stimulated demand for shipment. More inquiries are coming from abroad, and an increase is already noted in pig-iron from the Tees as compared with the similar period last month, South Wales having been a substantial buyer in the Cleveland market. Thus the outlook in this centre of the trade is distinctly brighter, as indicated in the announcement that the Skinningrove works are re starting two blast furnaces, while other firms are expected to follow shortly. The prices now governing the trade are :—No. 1 Cleveland and silicious, 95s. per ton; No. 3 G.M.B., 90s. per ton; No. 4 foundry, 87s. 6d. per ton; No. 4 forge, 82s. 6d. per ton. For mottled and white 80s. is a purely nominal quotation, and as there is a free market buyers could get iron at less than that figure.

The market for North-East Coast hematite indicates a steady improvement, trade with South Wales being on an increasing scale, while Sheffield is also renewing buying. Competition for orders is, however, keen, and it is no secret that although 97s. 6d per ton is still the general quotation for mixed numbers, business could be done at 95s. per ton, with No. 1 at the usual half-crown premium. There has been no further change in prices of West Cumberland hematite, the quotation remaining at £5 10s, or £6 5s delivered Sheffield.

Finished Iron.

The quarterly meeting of the iron trade at Birmingham last week was favoured with an exceptionally large attendance, and a brisk inquiry all-round for various classes of material encouraged the hope that business will shortly take a turn for the better. This was specially noteworthy in the case of finished iron, in which the inquiry was larger than has been experienced for some time, but whether as a testing movement of market values, or an actual increase in the demand for material, remains for the time being a matter for conjecture. At all events, buyers under the impression that further price reductions in finished material would materialise on this occasion were speedily disillusioned in this direction, the consensus of manufacturers' opinion being that quotations had already reached the lowest levels permissible by the cost of production, and that any additional concession would completely absorb the small remaining profit now available. Accordingly crown bars are apparently to still stand at £13 as the Association minimum, though it is well understood that makers of the commoner qualities of material are now freely offering at below that price. Makers of marked bars are in a somewhat more favourable position, but business in this section is by no means as brisk as could be desired, very few of the producing mills having more than average order sheets, with an uncertain prospect as to future renewals of specifications when the work in hand is completed.

Steel.

Industrial conditions in the steel trade are, as far as Sheffield is concerned, without convincing evidence of substantial improvement, but nevertheless there is an undercurrent suggesting an approach towards a partial revival of activity in the form of numerous inquiries for various products and some occasional orders placed for overseas contracts, giving a better prospect in the near future. Progress in this direction is, however, necessarily slow, and only a limited number of the principal works can be described as busy, buyers on general account, whether for home or export, apparently anticipating further price cuts, which would make a waiting policy justifiable. How far these expectations will be realised it is, of course, impossible to surmise, but with the recent reductions in hematite prices and lower wages costs it would appear as if further cuts in steel quotations are practically out of the question, these factors having already been discounted to a large extent. It may, however, be suggested that stocks of steel material at home and abroad must by this time be practically exhausted, and given more stable foreign exchange conditions there should be assured plenty of work for British manufacturers. In South Wales the steel sheet and tinplate bar works have a fair amount of orders on hand, but are anxious to secure more business, and are competing keenly for orders from districts outside the Association area. The Association at their meeting last week reduced the price of steel sheet and tinplate bars to £7 7s. 6d., and it is believed that certain users lowered the prices of their products for forward delivery some time back, in anticipation of this reduction.

Tinplates.

During the past week a rather better tendency has been noted in the tinplate market, but only a moderate business can be reported. Quotations ranged round 20s. to 20s. 3d. basis for spot delivery, and 19s. to 19s. 6d. for forward shipment over 2/3 months. The demand for coke wasters is only moderate. Prices are fairly steady at 39s. for CW 28 x 20 and 20s. for CW 14 x 18¾ f.o.b. Wales. Terneplates are in slightly better request. Transactions were reported at 19s. to 19s. 3d. basis, and these are about the figures being quoted to-day for approved specifications. All prices are net cash, f.o.b. Wales.

Metals.

Copper.—The week's business in the standard copper market has developed few features of more than passing interest, demand on home consumptive account continuing within moderate limits, while fluctuations in values have been on a corresponding scale. The tone throughout, however, has been fairly steady, with actual transactions mostly confined to small purchases. American demand is reported to be gaining more activity, two of the largest mines having lately resumed operations. The market for refined copper continues quiet but steady, electrolytic being quoted £73 to £74, with wire bars at similar figures. Closing prices :—Cash : Wednesday, £65 5s.; Thursday, £65 7s. 6d.; Friday, £65 10s.; Monday, £65 12s. 6d.; Tuesday, £65 2s. 6d. Three months: Wednesday, £66; Thursday, £66 5s.; Friday, £66 5s.; Monday, £66 7s. 6d.; Tuesday, £65 17s. 6d.

Tin.—Quiet conditions in the Welsh tinplate industry, and a poor general demand on home account have adversely affected the market for fine foreign tin, and the week's opening disclosed some weakness. This tendency was further accentuated by week-end Eastern advices, giving Straits tin sold at £169 10s. c.i.f., a decline of 30s. from the previous quotation. Notwithstanding these adverse factors, values remain fairly steady for both positions, January being done at £165 10s.; February, £165 10s.; March, £166 10s.; and April, £167. English ingots are quiet at £165. The home stocks of Straits have fallen to about 2,000 tons, and this tin is more tightly held at an increased premium to about £2 a ton, although there is plenty of other descriptions of tin held in stock, especially Dutch and English. Closing prices :—Cash, Wednesday, £165 12s. 6d.; Thursday, £167 5s.; Friday, £166 5s.; Monday, £165; Tuesday, £163 7s. 6d. Three months: Wednesday, £167 7s. 6d.; Thursday, £168 15s.; Friday, £168; Monday, £166 15s.; Tuesday, £165.

Spelter.—Demand for this metal of late has been disappointing, and prices have given way under selling pressure. Buying now is only on a hand-to-mouth scale, and both near and forward dates have shown a somewhat weaker tendency. Closing prices :—Wednesday, £27; Thursday, £26 17s. 6d.; Friday, £27; Monday, £26 17s. 6d.; Tuesday, £26 10s.

Lead.—A somewhat sharp reaction from previous active buying has been noted in the market for soft foreign pig, with a declining tendency in prices. Supplies of lead now coming forward are more plentiful, but demand appears to slacken, and consequently values are somewhat depressed. English closing prices :—Wednesday, £26; Thursday, £25 15s.; Friday, £25 15s.; Monday, £25 10s.; Tuesday, £25.

XUM

Company News.

Fodens, Limited.—Interim dividend passed.

Falkirk Iron Company, Limited.—Interim ordinary dividend, 5 per cent., less tax.

Guest, Keen & Nettlefolds, Limited.—Interim ordinary dividend, 5 per cent., tax free.

Electric Construction Company, Limited.—Interim ordinary dividend, 6 per cent. per annum.

Head, Wrightson & Company, Limited.—Interim ordinary dividend, 2½ per cent. per annum.

James Harrison & Company, Limited. — Capital £2,000. Engineers, etc. Secretary: R. Harrison, 32, Granville Terrace, Guiseley.

Taylor & Parsons, Limited.—Capital £30,000. Mill furnishers, etc. Directors: E. Tidswell, E. C. Heaton, and P. L. Heap. Registered office: Bradford.

T. B. Russell & Company, Limited.—Capital £10,000. Agricultural engineers, etc. Directors: G. F. Russell, T. B. Russell, C. Russell, and J. E. D. Shaw.

Sterling Accessories, Limited. — Capital £1,000. Permanent directors: C. J. Margerison and A. Handley. Registered office: Bangor House, Shoe Lane, E.C.

Boulton & Paul, Limited.—Credit balance, after transferring £11,911 from general reserve, £10,687; preference dividend recommended; carried forward, £8,187.

Steel Drums, Limited.—Capital £12,510 in 12,500 cumulative preference participating shares of £1 each, and 200 founders' of 1s. Registered office: 51, Fenchurch Street, E.C.

Fittings, Limited.—Capital £2,000 in £1 shares. Bedstead joint manufacturers. Secretary: W. H. Powell. Registered office: Whitehall Works, Tinsley Street, Great Bridge, Staffs.

Harvey & Spencer, Limited.—Capital £36,000 in £1 shares, to acquire the business of Messrs. Harvey and Spencer, mechanical engineers, etc. Registered office: 25, Victoria Street, Westminster, S.W.

Geo. Armitage (Leeds), Limited.—Capital £2,500. Iron and steel merchants, etc. Directors: G. Armitage (permanent governing director) and G. W. Armitage. Registered office: 97, Albion Street, Leeds.

Pepper Mill Brass Foundry, Limited. — Capital £31,000 in £1 shares (6,000 preference and 25,000 ordinary). Directors: A. H. Leech, H. Leech, and A. Thompson. Registered office: Darlington Street, Wigan.

Charles Cotton & Sons, Limited.—Capital £5,000 in £1 shares. Engineers. Directors: J. Cotton, H. Cotton, and A. Cotton. Secretary: C. Wilkinson. Registered office: Cottons' Works, off Scotland Road, Warrington.

Gazette.

A WINDING-UP PETITION has been presented against Metal Smelters, Limited.

A MEETING OF THE CREDITORS of the Martin Engineering Company, Limited, will be held at 15, Queen Street, London, E.C., on January 20.

THE BRENTFORD ALPHA ENGINEERING COMPANY, LIMITED, are being wound up voluntarily, with Mr. E. C. Savage, 4, York Street, Twickenham, as liquidator.

THE partnership heretofore subsisting between F. Peel and J. Emmott, ironfounders, 8, Thorton Street, Collyhurst, Manchester, trading under the style of Peel, Emmott & Company, has been dissolved.

THE shareholders of the Planet Electric Company, Limited, have decided to wind up the company voluntarily. Mr. S. H. Swallow, 67, Broad Street Avenue, London, E.C.2, has been appointed liquidator.

MESSRS. H. E. C. PEACOCK and J. Binnington, agricultural engineers, etc., 14-16, Pease Street, Kingston-upon-Hull, and the Old Foundry, Brigg, and New Road, Spalding, trading under the style of Peacock & Binnington, have dissolved partnership.

MR. D. HOPE has been elected a director of Nobel Industries, Limited, in the place of Mr. W. A. Tennant, who has retired from the board.

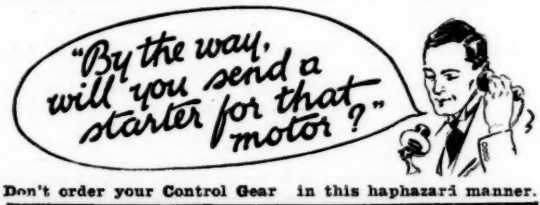
THE late Mr. R. C. Denton, J.P., The Oval, Harrogate, Yorks, a director of Dorman, Long & Company, Limited, and of the North-Eastern Steel Company, Limited, left £60,982.

Book Reviews.

MECHANICAL WORLD YEAR BOOK, 1922. Published by Messrs. Emmott & Company, Limited, 65, King Street, Manchester. Price 2s. 6d. net.—A new feature in this standard reference book of interest to foundrymen is the incorporation of a table giving the weights of fillets. Other new matter useful to the foundry is the section on pipes and tubes, which includes cast iron, wrought iron, steel and copper, and gives many tables of dimensions and particulars of flanged bends and tees, expansion bends, etc. Foundrymen will welcome the restoration of the tables on the thermal properties of solids, liquids and gases, which were deleted from last year's edition.

THE PREVENTION AND RELIEF OF HEART DISEASE, by C. Arthur Stephens, M.D. Published by Arthur H. Stockwell, 29, Ludgate Hill, E.C.4. Price 5s. net.—On receipt of this book for review we wondered what connection could exist between metallurgical industries and heart disease, but we find the book is a plea for the universal consideration of the subject in a similar manner to that bestowed upon consumption. The magnitude of the problem may be gauged from the report of a large and carefully managed insurance company, where, during four years, the rejections due to cardiac troubles were 24.4 per 1,000. Obviously people realising that they were suffering from heart troubles would not apply, therefore the figures may be still higher. Further evidence is given by the Health Department of New York City, where the examination of 250,000 children showed that 1.6 per cent. had evidences of cardiac disorder. It is also stated that one-fifth of the deaths of persons over 40 years of age can also be similarly attributed. For the relief of heart diseases, Dr. Stephens insists that special attention should be given to the occupation for cardiacs. Additionally, he advocates the establishment of convalescent homes and permanent institutional care. We would advise all foundrymen to bring this book to the notice of their welfare superintendents, who, together with the works doctors, will be able to judge whether Dr. Stephens has made out his case sufficiently well as to justify national co-operative action by the great metallurgical industries.

Krupp Company's Workmen Shares.—It was mentioned recently that the Fried. Krupp Company has decided to increase the share capital from 250 to 500 millions of marks. One portion of the new issue is to take the form of cumulative preference shares, 1,000 marks each, to be termed D shares, which will yield 6 per cent. and may rise to 10 per cent. These D shares are to be offered to the Company's workmen at the price of 110 per cent. and can only be held by them. The shares subscribed will be administered by a Krupp Trustee Association, to be registered for the purpose. The directors express the hope that by affording their workmen an opportunity for financially participating in the Company they will promote social peace. On the other hand, an Essen labour organ states that the whole scheme is really a request to the workmen to hand over in exchange for shares the 74,000,000 marks which they have as credit and savings' deposits with the Krupp Company.



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